Generation Retirement Transmission Impact Analysis

for

DESC Wateree and Williams Generating Plants

Prepared for:

Dominion Energy Services

January 5, 2022

Prepared by:

Dominion Energy South Carolina (DESC)

Transmission Planning

This analysis was performed as part of the DESC Integrated Resource Planning process, as referenced in the DESC Modified 2020 IRP Short-term Action Plan, and in accordance with SC PSC Order No. 2020-832 (see pp. 34-40)

REVISION HISTORY

REV	DESCRIPTION	DATE
0	Initial Release	01/05/2022

Contents

Generation Retirement Transmission Impact Analysis for Retirement of DESC Wateree and Williams Generating Plants

General Discussion

As part of the Integrated Resource Planning (IRP) process, as referenced in the Dominion Energy South Carolina, Inc. (DESC) Modified 2020 IRP Short-term Action Plan, and in accordance with the order of the Public Service Commission of South Carolina (SC PSC), SC PSC Order No. 2020-832 (see pp. 34-40), DESC is evaluating the retirement of several generating plants. As part of this evaluation, Dominion Energy Services' Strategic Planning group requested this Generation Retirement Transmission Impact Analysis (Impact Analysis) via letter dated February 16, 2021, as modified on April 6, 2021, and May 13, 2021, respectively. This analysis is consistent with Federal Energy Regulatory Commission (FERC) Order No. 717, which permits the sharing of transmission information to facilitate long range and integrated resource planning of generation and transmission.

This Impact Analysis provides a preliminary evaluation of the system impacts and costs of retiring the Wateree and Williams Generating Plants from the DESC system and replacing them with a variety of resources prescribed in five different cases. This Impact Analysis is the result of extensive transmission system modeling and simulation, and was used to develop a list of network upgrades that would be required under each case. The Impact Analysis also includes a non-binding good faith estimate of costs and time to construct the upgrades under each case.

Inputs to the assessment included all previously planned transmission system upgrades, and all generator interconnection requests with an executed and active Interconnection Agreement. Once DESC has made a final decision regarding the retirement of these plants and their corresponding resource replacements, DESC must submit formal interconnection requests under the FERC-approved DESC Large Generator Interconnection Process (LGIP), which will be placed in the DESC Interconnection Request queue. At such time, and as part of the interconnection process, DESC Transmission Planning will prepare refined estimates of the cost and time to construct the corresponding necessary transmission upgrades that will result from those requests.

The Impact Analysis request from Dominion Energy Services' Strategic Planning group to DESC Transmission Planning contained five cases in which Wateree (684MW winter) and Williams (610MW winter) plants are retired and replaced with various configurations of on-system combined cycles turbines, solar generators, energy storage systems, and off-system capacity purchases. The five cases are as follows:

> **Case 1** – Retire Wateree in 2025; add a 200 MW battery Energy Storage System ("ESS") and 200 MW PV solar generation at Wateree, and contract for 200 MW off-system

purchased power beginning late in 2025. Retire Williams in 2028 and add a 534 MW 1X1 CC at Jasper and add a 200MW ESS and 200 MW PV solar generation at Canadys.

Wateree (684 MW) is retired late in 2025 and replacement resources are available immediately. Build a utility-owned or PPA-provided 200 MW-AC dispatchable ESS facility and a 200 MW-AC utility-owned or PPA-provided flexible PV solar generator at the Wateree site and the Company's existing 230kV interconnection. DESC would also enter a 3-year PPA for 200 MW of off-system capacity-backed energy on a firm path from the Southern Company (SOCO) interface. Retire Williams late in 2028 and replacement generation is available immediately. A 534 MW 1X1 CC with a 6,200 BTU/kWh heat rate and minimum up and down time of sixteen hours is constructed and interconnected at the DESC Jasper site with the existing unit to the Company's 230kV transmission system. These combined-cycle generation blocks have a minimum load of 281 MW. Build a utility-owned or PPA-provided 200 MW-AC dispatchable ESS facility and a 200 MW-AC utility-owned or PPA-provided flexible PV solar generator at the Canadys site and interconnection.

Case 2 – Retire Wateree and Williams in 2028; build a 1X1 CC and pair of frame-built CTs at Jasper.

Wateree and Williams are retired simultaneously in 2028 and replacement generation is available immediately. A 534 MW 1X1 CC with a 6,200 BTU/kWh heat rate and minimum up and down time of sixteen hours is constructed and interconnected at the DESC Jasper Station site to the Company's 230kV transmission system. These combined-cycle generation blocks have a minimum load of 281 MW. A 523 MW 2X0 pair of frame-built CTs is constructed and interconnected at the DESC Jasper Station site to the Company's 230kV transmission system.

Case 3 – Retire Wateree and Williams in 2028; build a 1X1 CC and pair of frame-built CTs at Canadys Wateree and Williams are retired simultaneously in 2028 and replacement generation is available immediately. A 534 MW 1X1 CC with a 6,200 BTU/kWh heat rate and minimum up and down time of sixteen hours is constructed and interconnected at the former DESC Canadys Station site to the Company's 230kV transmission system. These combined-cycle generation blocks have a minimum load of 281 MW. A 523 MW 2X0 pair of frame-built CTs is constructed and interconnected at the former DESC Canadys Station site to the Company's 230kV transmission system.

Case 4 – Retire Wateree and Williams in 2028; build a 1X1 CC at Canadys, add a 200 MW ESS and 200 MW PV solar generation at Wateree, and contract for 400 MW off-system purchased power.

Wateree and Williams are retired simultaneously in 2028 and replacement resources are available immediately. A 534 MW 1X1 CC with a 6,200 BTU/kWh heat rate and minimum up and down time of sixteen hours is constructed and interconnected at the former DESC Canadys Station site to the Company's 230kV transmission system. Build a utility-owned or contract for 200 MW-AC dispatchable ESS facility and a 200 MW-AC utility-owned or PPA-provided flexible and dispatchable PV solar generator at the Wateree site. DESC would enter a 10-year PPA for 400 MW of off-system capacity-backed energy on a firm path from the SOCO interface beginning late in 2028.

Case 5 – Retire Wateree and Williams in 2028; contract for an 1,100 MW off-system long-term power purchase.

Wateree and Williams are retired simultaneously in 2028 and a replacement PPA is available immediately. DESC would enter a 10-year PPA for 1,100 MW of off-system capacity-backed energy on a firm path from the SOCO interface or SOCO and DUKE interfaces beginning late in 2028.

CT Options for Williams – If the analysis in any of the above defined cases determines that some replacement generation must be sited at the Williams Station site to maintain system reliability or to economically overcome transmission system contingencies, please add 117 MW winter rating dual-fuel aeroderivative CTs, incrementally, as needed. If it can be determined that 117 MW units could significantly reduce the transmission upgrade cost for the cases above, please identify the transmission cost savings per MW of generation replaced at the Williams Station site.

Wateree Station, located in Eastover, SC, is DESC's largest coal-fired generation station with two generators of approximately 341 MW each. The station's switchyard contains multiple 230kV transmission lines and is centrally located on the DESC Transmission System. Its geographic location benefits the DESC transmission system by supporting the northern load pockets of the greater Columbia area and the southern load pockets of the greater Charleston area. Wateree however is not located directly in a DESC load center, and the retirement of Wateree alone is not expected to create significant transmission constraints. However, replacing the generators with alternative sources, whether by on-system DESC generators or off-system purchases, will create constraints that must be mitigated.

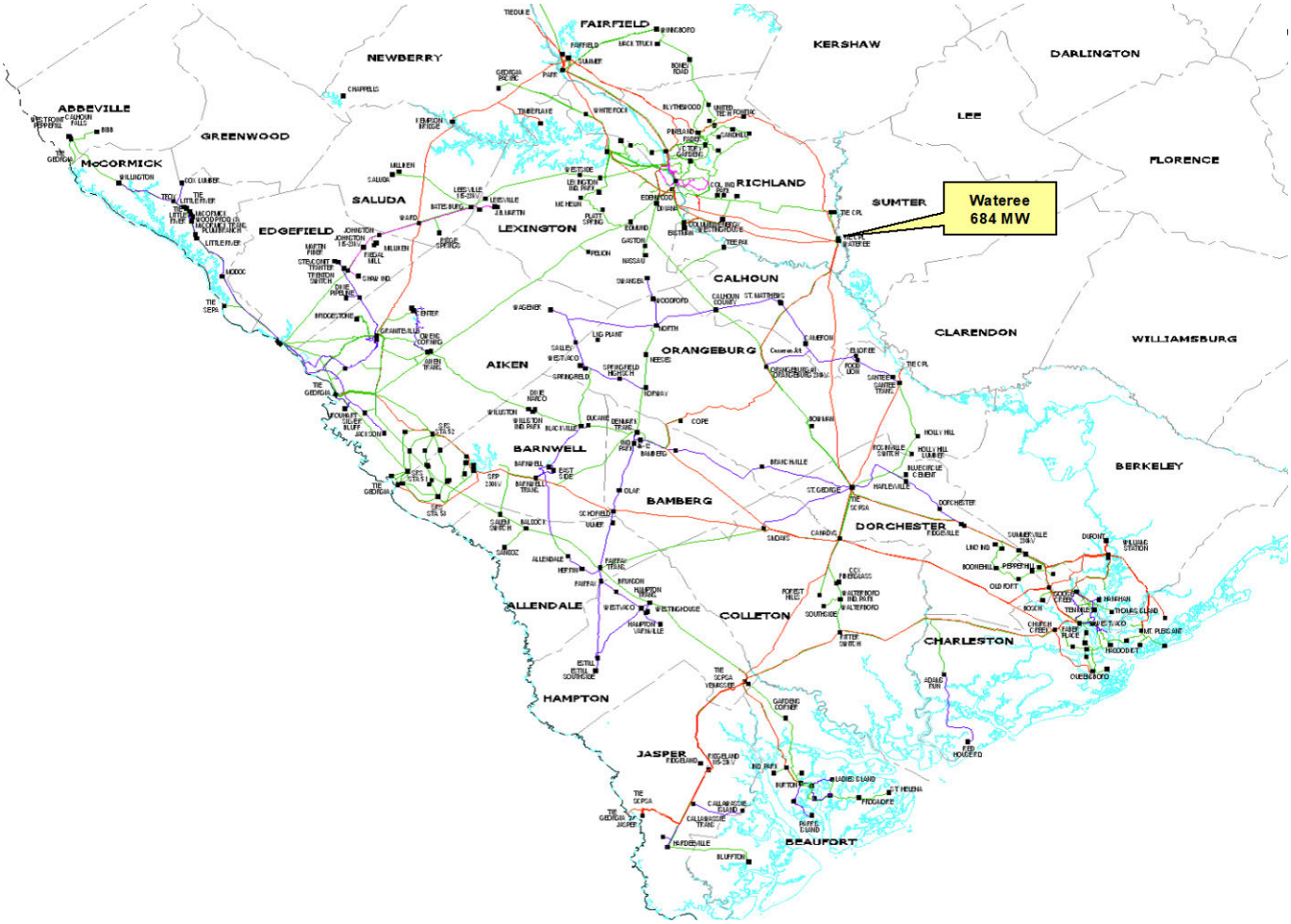

Figure 1 – Wateree Station Location
(Line colors: red – 230kV, green – 115kV, purple – 46kV)

Williams Station, located in Goose Creek, SC, is DESC's largest single coal-fired generating unit and the closest large source of generation to the dense load pockets in the greater Charleston area. Retiring this generator is expected to result is significant transmission constraints that will require mitigation. This generator serves a vital role in providing essential reliability services to the low country area of South Carolina. Replacing the generator at Williams Station with alternative sources of power such as new on-system DESC generators or off-system purchases, will create a separate set of constraints that must also be remedied.

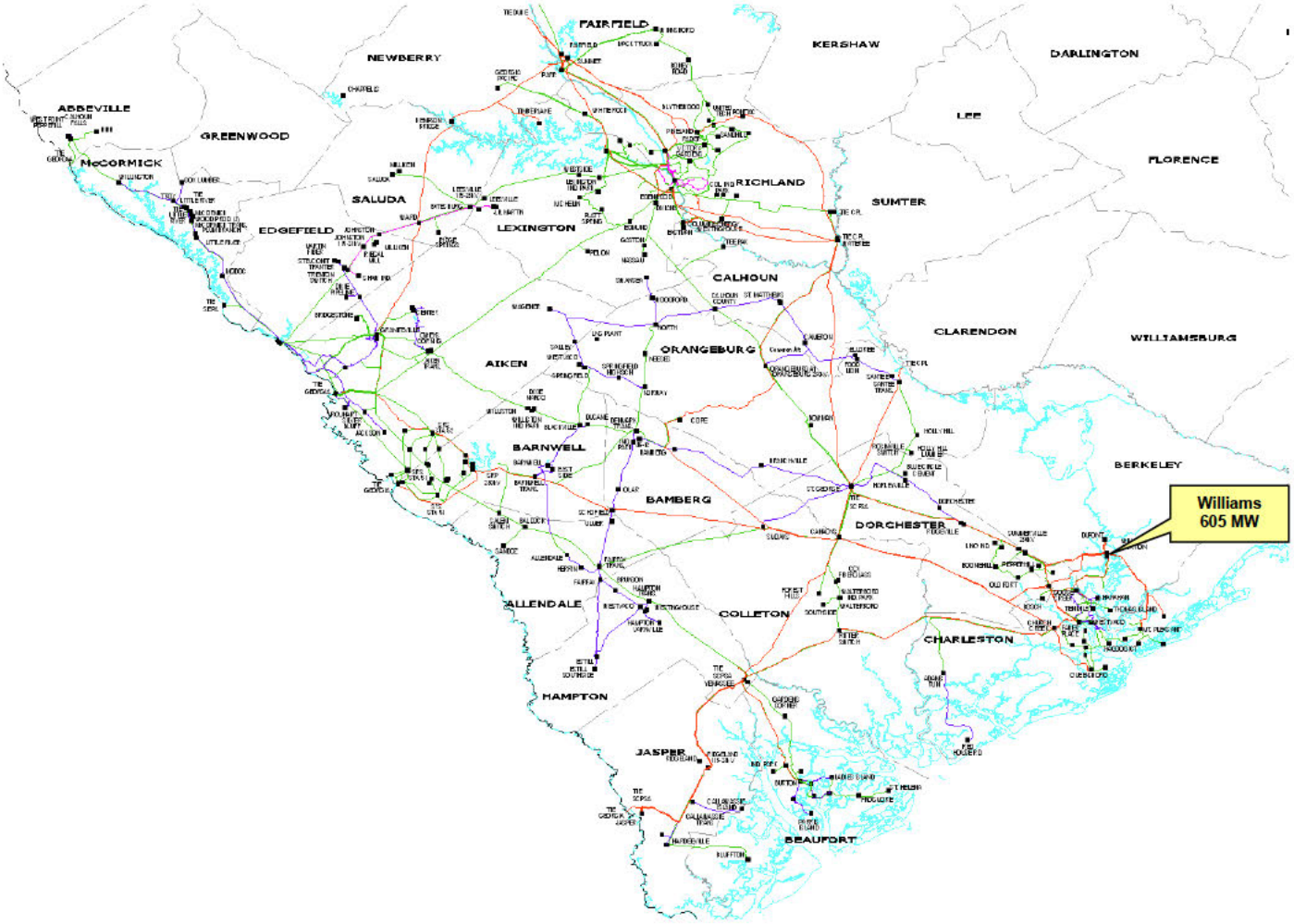

Figure 2 – Williams Station Location
(Line colors: red – 230kV, green – 115kV, purple – 46kV)

The models used in this Impact Analysis are regionally developed base cases that include assumptions from transmission expansion plans of DESC and other transmission providers. Projects in these

transmission expansion plans are subject to modifications, cancellations, and re-scheduling, any of which could affect the predicted outcomes and conclusions. For this reason, changes to transmission system expansion plans may prompt a need for further analysis to reevaluate the predicted impact to the planned retirement of Wateree and Williams in this report.

Other southeastern utilities are also in the process of assessing the accelerated retirement of their respective coal plants. In combination, such large-scale changes can have unforeseen consequences on the power grid if not effectively coordinated and thoroughly studied. To address this, DESC Transmission Planning coordinated with neighboring utilities to better understand the possible impacts of neighboring coal-fired generators from the southeast portion of the grid. The results provided in this report include collective best efforts to capture the various impacts to the DESC system and the associated projects necessary to ensure compliance with DESC and NERC planning requirements. Due to the highly integrated nature of the DESC and the South Carolina Public Service Authority (SCPSA) Transmission Systems, studies were conducted with SCPSA to also capture the impact of the planned retirement of the SCPSA Winyah Generation Plant (Winyah) which produces approximately 1150MW.

Transmission Impact Analysis

Power Flow Analysis

The Power Flow Analyses for this analysis were performed with PowerWorld Simulator Version 22. The following 2021 SERC Long-Term Working Group (LTWG) base cases were used to perform the power flow portion:

- 2026 Shoulder (converted to 2029 Spring Peak)
- 2031 Summer Peak
- 2031 Winter Peak

These base cases were modified to include DESC's internal planning models as of May 2021. These DESC models reflect currently planned transmission improvements and updates to the generation fleet per the scenarios in the five cases listed above. Updates to models were frozen at the start of the analyses in May of 2021 so that all scenarios were performed with a consistent set of assumptions.

As mentioned above, DESC performed this Impact Analysis collaboratively with SCPSA. SCPSA has announced the planned retirement of Winyah plant at approximately the same time as that proposed for Wateree and Williams, depending on the case. Each company was keen to capture the effects of the other company's plant retirements in its planning. SCPSA is evaluating several scenarios for the retirement of Winyah plant. Those scenarios were incorporated into the work performed by DESC for this report.

Contingency Analysis Criteria

Any contingencies in the Impact Analysis which resulted in loading greater than 90% of the Emergency, or 'B' rating, of an element were identified and upgrades were developed to bring post-contingency loading below 90%. This was done to meet all NERC category planning events as described in NERC TPL-001-04, and to meet all other DESC Transmission Planning Thermal and Voltage criteria. DESC performed a full TPL contingency analysis for this assessment. DESC Transmission Planning defines N-1 contingencies as those NERC Single and Multiple Contingency events that do not allow for system adjustments to be performed during the event. N-1 contingencies include NERC Category P1, P2, P4, P5 and P7 events. N-1-1 contingencies are those NERC Multiple Contingency Events that allow for system adjustment following the first event – these include NERC Category P3 and P6 events as well as P2 contingencies combined with long term outages (underground lines).

Actual system conditions experienced in operations can vary from the assumptions made in this analysis. The 90% loading value is used to account for variations in actual system conditions that

can occur in real-time. This accounts for variation in conditions and assumptions studied while ensuring facility limits are not exceeded.

Iterative Process Discussion

Due to the large size of the coal generators being evaluated for retirement (over 25% of DESC's fleet necessary to meet historical peak) and their importance to the reliability of the DESC and SCPSA Transmission Systems, an iterative analysis process was implemented. Network upgrades were implemented incrementally to carefully determine only those that were necessary. Upgrading lines by rebuilding them typically lowers impedances, which can force electrical power to flow more heavily in unwanted areas; but rebuilding lines is usually the only way to ensure overloads do not occur.

Presentation of Results

The contingency summary results presented in this report only document the overloads found for each case with the corresponding worst associated contingency. Said another way, there may have been many different contingencies that cause a particular transmission facility to overload; this report only attempts to document the worst contingency result for each overloaded facility.

The results presented in this report assume SCPSA chooses the replacement option for Winyah that is most challenging to DESC. This SCPSA option is consistent across all DESC cases in this report. That said, the SCPSA system upgrades vary with each DESC case even for the same SCPSA Winyah replacement option. The changes in SCPSA system topologies between DESC cases result in variations to certain contingencies and associated upgrades between DESC cases. Simply put, the addition or absence of a SCPSA tie or major SCPSA system upgrade can greatly impact DESC system power flows across the different Wateree/Williams retirement cases.

The transmission upgrade tables presented in this report summarize the transmission projects that would be necessary to resolve the overloaded facilities, including the estimated cost, the necessary time to complete, the miles of transmission lines needed, the miles of new right-of-way (ROW) needed, and the number of new substations required. The projects, even ones with the same name, may vary between each of the five different cases based on the specific needs of each case.

Transmission Impact Analysis Results

Case 1

Case 1 was studied in two phases based on the 2025 and 2028 retirement dates of Wateree and Williams respectively.

Case 1, Phase 1 consists of:

- The retirement of Wateree in 2025
- The addition of 200 MW battery Energy Storage System ("ESS") at Wateree
- The addition of 200 MW PV generation at Wateree
- And the addition of a 200 MW off-system purchase contract beginning in late 2025
- The modeling of the SCPSA system as it is in the 2021 MMWG update for 2026 cases

Case 1, Phase 2 consists of:

- The retirement of Williams in 2028
- The addition of a 534 MW 1X1 CC at Jasper
- And the addition of a 200MW ESS and 200 MW PV solar generation at Canadys

Case 1, Phase 1 Results:

Table 1-1: Single (N-1) Contingency Summary (Case 1)

Limiting Element	Worst Contingency	Loading ('B' Rating)
N/A	N/A	N/A

Table 1-2: Multiple (N-1-1) Contingency Summary (Case 1)

Limiting Element	Worst Contingencies	Loading ('B' Rating)
[redacted]	[redacted]	106%
[redacted]	[redacted]	102%
[redacted]	[redacted]	100%

Limiting Element	Worst Contingencies	Loading ('B' Rating)
[redacted]	[redacted]	94%
[redacted]	[redacted]	94%
[redacted]	[redacted]	93%
[redacted]	[redacted]	92%

The following table describes the DESC transmission upgrades that would be necessary to mitigate the issues described in Table 1-1 and Table 1-2 for Case 1:

Table 1-3: Required Upgrades (Case 1)

Project Title	Project Work	Cost Estimate	Time Estimate (months)	Line Mileage	New Lines w/o ROW	New ROW Line Miles	New Stations
[redacted]							
	Acquire R/W	$5,445,000	36		1	30	
	[redacted]	$72,200,000	36	30			
		$500,000	12				
		$80,000	18				
		$734,000	24				
	Total	**$78,959,000**	**72**	**30**	**1**	**30**	**0**
[redacted]							
	Acquire Site	$80,000	18				
	Transmission work to fold	$500,000	18	0.5			
	Reactor Substation: Construct	$2,937,000	30				1
	Total	**$3,517,000**	**36**	**0.5**	**0**	**0**	**1**
[redacted]							
		$54,000,000	42	36			
		$8,193,750	36				
		$873,000	24				
		$873,000	24				
	Total	**$63,939,750**	**78**	**36**	**0**	**0**	**0**
	Grand Total	**$146,415,750**	**>=78**	**66.5**	**1**	**30**	**1**

Notes:

- *Feasibility of new tie lines with neighboring utilities (other than SCPSA) has not been assessed by those utilities*
- *Time estimates assume the outages necessary to construct the upgrade projects do not conflict with each other; that is unlikely to be the case*

Case 1, Phase 2 Results:

Thermal results are shown in the tables below; however, voltage results can be summarized by noting that, due to many various contingencies, widespread low voltage was observed below 0.95 per unit for the greater Charleston area and was as low as 0.80 per unit at many substations. The transmission projects identified to resolve thermal loadings also corrected the voltage violations.

Table 1-4: Single (N-1) Contingency Summary (Case 1)

Limiting Element	Worst Contingency	Loading ('B' Rating)
[redacted]	[redacted]	129%
[redacted]	[redacted]	116%
[redacted]	[redacted]	94%
[redacted]	[redacted]	93%
[redacted]	[redacted]	91%

Table 1-5: Multiple (N-1-1) Contingency Summary (Case 1)

Limiting Element	Worst Contingency	Loading ('B' Rating)
[redacted]	[redacted]	139%
[redacted]	[redacted]	137%
[redacted]	[redacted]	108%
[redacted]	[redacted]	104%
[redacted]	[redacted]	103%
[redacted]	[redacted]	93%
[redacted]	[redacted]	92%

Limiting Element	Worst Contingency	Loading ('B' Rating)
[redacted]	[redacted]	92%
[redacted]	[redacted]	91%
[redacted]	[redacted]	90%
[redacted]	[redacted]	90%

The following table describes the DESC transmission upgrades that would be necessary to mitigate the issues described in Table 1-4 and Table 1-5 for Case 1:

Table 1-6: Required Upgrades (Case 1)

Project Title	Project Work	Cost Estimate	Time Estimate (months)	Line Mileage	New Lines w/o ROW	New ROW Line Miles	New Stations
[redacted]							
	Acquire Site	$4,550,000	18				
	Acquire R/W	$6,750,000	18				
	[redacted]	$7,669,000	30				1
		$1,750,000	30	1		1	
		$120,000	18				
	s)	$120,000	18				
		$2,759,000	30				
		$120,000	18				
		$1,750,000	30	1			
		$1,750,000	30	1			
		$2,900,000	18	0.7		0.7	
		$22,000,000	36	10			
	Total	**$52,238,000**	**48**	**13.7**	**0**	**1.7**	**1**
[redacted]							
	Transmission Work for Fold In	$2,000,000	24	0.5			
	[redacted]	$120,000	24				
		$80,000	18				
		$80,000	18				
	Total	**$2,280,000**	**24**	**0.5**	**0**	**0**	**0**
[redacted]							
	Rebuild the 230/115kV Line	$8,250,000	36	3.75			
	[redacted]	$151,000	18				

Project Title	Project Work	Cost Estimate	Time Estimate (months)	Line Mileage	New Lines w/o ROW	New ROW Line Miles	New Stations
	[redacted]	$136,000	18				
	Total	$8,537,000	36	3.75	0	0	0
	[redacted]						
	1-1000 Cu to 2-1000 Cu at 12" apart, 1 ¼" Cu pipe to 5" Sch 40 Al	$90,000	24				
	Total	$90,000	24	0	0	0	0
	[redacted]						
		$78,400,000	54	32			
		$32,800,000	54	15			
		[redacted]	[redacted]				
		$575,000	18				
		$475,000	18				
		$750,000	18				
		$550,000	18				
		$75,000	18				
		$92,000	18				
		$53,000	18				
		$791,000	24				
		$500,000	18				
		$1,245,000	24				
	Total	$117,256,000	54	47	0	0	0
	[redacted]						
	Clear and Grade Site	$600,000	18				
	[redacted]	$7,000,000	30				1
		$727,000	24				
		$1,000,000	36				
		$875,000	36				

Project Title	Project Work	Cost Estimate	Time Estimate (months)	Line Mileage	New Lines w/o ROW	New ROW Line Miles	New Stations
	[redacted]	$1,464,000	24				
	Total	$11,666,000	36	0	0	0	1
	[redacted]	$4,375,000	48	2.5			
		$7,600,000	42				
		$873,000	24				
		$160,000	24				
		$80,000	18				
		$80,000	18				
	Total	$13,168,000	48	2.5	0	0	0
	Grand Total	$205,235,000	>=72	67.45	0	1.7	2
	Case 1 Total	$351,650,750	>=78	133.95	1	31.7	3

Notes:

- *Feasibility of new tie lines with neighboring utilities (other than SCPSA) has not been assessed by those utilities*
- *Time estimates assume the outages necessary to construct the upgrade projects do not conflict with each other; that is unlikely to be the case.*

Case 2

Case 2 consists of:

- The retirement of Wateree and Williams in 2028
- The addition of a 534 MW 1x1 CC unit at Jasper
- The addition of 523 MW 2X0 pair of frame-built CTs at Jasper

Results:

Case 2 consists of:

- The retirement of Wateree and Williams in 2028
- The build of a 534 MW 1X1 CC with a 6,200 BTU/kWh heat rate on the 230kV system at Jasper Station
- The build of a 523MW 2X0 pair of frame-built CTs on the 230kV system at Jasper

Thermal results are shown in the tables below; however, voltage results can be summarized by noting that, due to many various contingencies, widespread low voltage was observed below 0.95 per unit for the greater Charleston area and was as low as 0.80 per unit at many substations. The transmission projects identified to resolve thermal loadings also corrected the voltage violations.

Table 2-1: Single (N-1) Contingency Summary (Case 2)

Limiting Element	Worst Contingency	Loading ('B' Rating)
[redacted]	[redacted]	140%
[redacted]	[redacted]	123%
[redacted]	[redacted]	111%
[redacted]	[redacted]	101%
[redacted]	[redacted]	98%
[redacted]	[redacted]	93%
[redacted]	[redacted]	91%
[redacted]	[redacted]	91%
[redacted]	[redacted]	90%
[redacted]	[redacted]	90%

Table 2-2: Multiple (N-1-1) Contingency Summary (Case 2)

Limiting Element	Worst Contingency	Loading ('B' Rating)
[redacted]	[redacted]	170%
[redacted]	[redacted]	132%
[redacted]	[redacted]	129%
[redacted]	[redacted]	126%
[redacted]	[redacted]	119%
[redacted]	[redacted]	116%
[redacted]	[redacted]	108%
[redacted]	[redacted]	108%
[redacted]	[redacted]	101%
[redacted]	[redacted]	100%
[redacted]	[redacted]	98%
[redacted]	[redacted]	96%
[redacted]	[redacted]	96%
[redacted]	[redacted]	96%
[redacted]	[redacted]	96%
[redacted]	[redacted]	95%

Limiting Element	Worst Contingency	Loading ('B' Rating)
[redacted]	[redacted]	94%
[redacted]	[redacted]	92%
[redacted]	[redacted]	91%
[redacted]	[redacted]	91%
[redacted]	[redacted]	91%

The following table describes the DESC transmission upgrades that would be necessary to mitigate the issues described in Table 2-1 and Table 2-2 for Case 2:

Table 2-3: Required Upgrades (Case 2)

Project Title	Project Work	Cost Estimate	Time Estimate	Line Mileage	New Lines w/o ROW	New ROW Line Miles	New Stations
[redacted]							
	Acquire Site	$4,550,000	18				
	Acquire R/W	$6,750,000	18				
	[redacted]	$7,669,000	30				1
		$1,750,000	18	1		1	
		$120,000	18				
		$120,000	18				
		$2,759,000	30				
		$120,000	18				
		$1,750,000	18	1			
		$1,750,000	18	1			
		$2,900,000	18	0.7		0.7	
		$22,000,000	10				
	Total	**$52,238,000**	**48**	**13.7**	**0**	**1.7**	**1**
[redacted]							
	Transmission Work for Fold In	$2,000,000	18	0.5			
	[redacted]	$120,000	24				
		$80,000	18				
		$80,000	18				
	Total	**$2,280,000**	**24**	**0.5**	**0**	**0**	**0**
[redacted]							
	Acquire R/W	$5,445,000	36		1	30	

Project Title	Project Work	Cost Estimate	Time Estimate	Line Mileage	New Lines w/o ROW	New ROW Line Miles	New Stations
	[redacted]	$72,200,000	36	30			
		$500,000	12				
		$80,000	18				
		$734,000	24				
	Total	**$78,959,000**	**96**	**30**	**1**	**30**	**0**
	[redacted]						
	[redacted]	$4,995,000	48		1	55	
		$104,000,000	48	55			
		$873,000	24				
		$873,000	24				
	Total	**$110,741,000**	**96**	**55**	**1**	**55**	**0**
	[redacted]						
	Acquire Site	$80,000	18				
	Transmission work to fold	$500,000	18	0.5			
	Reactor Substation: Construct	$2,937,000	30				1
	Total	**$3,517,000**	**36**	**0.5**	**0**	**0**	**1**
	[redacted]						
	[redacted]	$8,250,000	36	3.75			
		$151,000	18				
		$136,000	18				
	Total	**$8,537,000**	**36**	**3.75**	**0**	**0**	**0**
	[redacted]						
		$78,400,000	54	32			
		$32,800,000	54	15			

Project Title	Project Work	Cost Estimate	Time Estimate	Line Mileage	New Lines w/o ROW	New ROW Line Miles	New Stations
	[redacted]	$950,000	18				
		$575,000	18				
		$475,000	18				
		$750,000	18				
		$550,000	18				
		$75,000	18				
		$92,000	18				
		$53,000	18				
		$791,000	24				
		$500,000	18				
		$1,245,000	24				
	Total	**$117,256,000**	**54**	**47**	**0**	**0**	**0**
[redacted]							
Clear and Grade Site		$600,000	18				
[redacted]		$7,000,000	30				1
		$727,000	24				
		$1,000,000	36				
		$875,000	36				
		$1,464,000	24				
	Total	**$11,666,000**	**36**	**0**	**0**	**0**	**1**
[redacted]							
Add R/W		$883,636	24				
Transmission Construction		$14,904,000	30	3			
[redacted]		$873,000	24				
		$873,000	24				
	Total	**$17,533,636**	**30**	**3**	**0**	**0**	**0**

Project Title	Project Work	Cost Estimate	Time Estimate	Line Mileage	New Lines w/o ROW	New ROW Line Miles	New Stations
[redacted]		$450,000	24				
	Total	$450,000	24	0	0	0	0
	Grand Total	$403,177,636	>=96	153.45	2	86.7	3

Notes:

- *Feasibility of new tie lines with neighboring utilities (other than SCPSA) has not been assessed by those utilities*
- *Time estimates assume the outages necessary to construct the upgrade projects do not conflict with each other; that is unlikely to be the case.*

Case 3

Case 3 consists of:

- The retirement of Wateree and Williams in 2028
- The addition of a 534 MW 1x1 CC unit at Canadys
- The addition of 523 MW 2X0 pair of frame-built CTs at Canadys

Results:

Thermal results are shown in the tables below; however, voltage results can be summarized by noting that, due to many various contingencies, widespread low voltage was observed below 0.95 per unit for the greater Charleston area and was as low as 0.80 per unit at many substations. The transmission projects identified to resolve thermal loadings also corrected the voltage violations.

Table 3-1: Single (N-1) Contingency Summary (Case 3)

Limiting Element	Worst Contingency	Loading ('B' Rating)
[redacted]	[redacted]	138%
[redacted]	[redacted]	126%
[redacted]	[redacted]	105%
[redacted]	[redacted]	105%
[redacted]	[redacted]	105%
[redacted]	[redacted]	100%
[redacted]	[redacted]	97%
[redacted]	[redacted]	96%
[redacted]	[redacted]	95%
[redacted]	[redacted]	94%
[redacted]	[redacted]	92%
[redacted]	[redacted]	90%

Table 3-2: Multiple (N-1-1) Contingency Summary (Case 3)

Limiting Element	Worst Contingencies	Loading ('B' Rating)
[redacted]	[redacted]	152%
[redacted]	[redacted]	133%
[redacted]	[redacted]	130%
[redacted]	[redacted]	118%
[redacted]	[redacted]	115%
[redacted]	[redacted]	111%
[redacted]	[redacted]	103%
[redacted]	[redacted]	99%
[redacted]	[redacted]	98%
[redacted]	[redacted]	98%
[redacted]	[redacted]	97%
[redacted]	[redacted]	96%
[redacted]	[redacted]	94%
[redacted]	[redacted]	93%
[redacted]	[redacted]	93%
[redacted]	[redacted]	92%

Limiting Element	Worst Contingencies	Loading ('B' Rating)
[redacted]	[redacted]	92%
[redacted]	[redacted]	91%

The following table describes the proposed DESC transmission upgrades to mitigate the issues described in Table 3-1 and Table 3-2 for Case 3:

Table 3-3: Required Upgrades (Case 3)

Project Title	Project Work		Cost Estimate	Time Estimate	Line Mileage	New Lines w/o ROW	New ROW Line Miles	New Stations
[redacted]								
	Acquire Site		$80,000	18				
	Transmission work to fold		$500,000	18	0.5			
	Reactor Substation: Construct		$2,937,000	30				1
		Total	**$3,517,000**	**36**	**0.5**	**0**	**0**	**1**
[redacted]								
			$8,250,000	36	3.75			
			$151,000	18				
			$136,000	18				
		Total	**$8,537,000**	**36**	**3.75**	**0**	**0**	**0**
[redacted]								
			$4,375,000	48	2.5			
			$7,600,000	42				
			$873,000	24				
			$160,000	24				
			$80,000	18				
			$80,000	18				
		Total	**$13,168,000**	**48**	**2.5**	**0**	**0**	**0**
[redacted]								
			$88,200,000	48	36			
			$20,000	18				
			$50,000	18				
		Total	**$88,270,000**	**48**	**36**	**0**	**0**	**0**

Project Title	Project Work	Cost Estimate	Time Estimate	Line Mileage	New Lines w/o ROW	New ROW Line Miles	New Stations
[redacted]		$59,500,000	48	30			
		$60,000	18				
	Total	$59,560,000	48	30	0	0	0
[redacted]		$850,000	36				
		$100,000	18				
	Total	$950,000	36	0	0	0	0
[redacted]		$2,000,000	30				
	Total	$2,000,000	30	0	0	0	0
[redacted]		$82,000,000	48	40			
		$22,000,000	36	10			
		$3,000,000	30				
		$732,000	24				
	Total	$107,732,000	48	50	0	0	0
[redacted]		$3,750,000	24				
		$10,000	18				
		$244,000	24				
	Total	$4,004,000	24	10	0	0	0
[redacted]		$14,950,000	48				
		$3,000,000	36				
		$3,000,000	36				

Project Title	Project Work	Cost Estimate	Time Estimate	Line Mileage	New Lines w/o ROW	New ROW Line Miles	New Stations
	Total	$20,950,000	48	0	0	0	0
	Grand Total	$308,688,000	>=48	132.75	0	0	1

Notes:

- *Feasibility of new tie lines with neighboring utilities (other than SCPSA) has not been assessed by those utilities*
- *Time estimates assume the outages necessary to construct the upgrade projects do not conflict with each other; that is unlikely to be the case.*

Case 4

Case 4 consists of:

- The retirement of Wateree and Williams in 2028
- The addition of a 534 MW 1x1 CC unit at Canadys
- The addition of 200 MW ESS at Wateree
- The addition of 200 MW PV solar generation at Wateree
- Contract for 10-year PPA for 400 MW of off-system purchase power

Results:

Thermal results are shown in the tables below; however, voltage results can be summarized by noting that, due to many various contingencies, widespread low voltage was observed below 0.95 per unit for the greater Charleston area and was as low as 0.80 per unit at many substations. The transmission projects identified to resolve thermal loadings also corrected the voltage violations.

Table 4-1: Single (N-1) Contingency Summary (Case 4)

Limiting Element	Worst Contingency	Loading ('B' Rating)
[redacted]	[redacted]	126%
[redacted]	[redacted]	98%
[redacted]	[redacted]	97%
[redacted]	[redacted]	95%
[redacted]	[redacted]	94%
[redacted]	[redacted]	93%
[redacted]	[redacted]	92%

Table 4-2: Multiple (N-1-1) Contingency Summary (Case 4)

Limiting Element	Worst Contingency	Loading ('B' Rating)
[redacted]	[redacted]	155%
[redacted]	[redacted]	119%
[redacted]	[redacted]	113%
[redacted]	[redacted]	112%
[redacted]	[redacted]	111%
[redacted]	[redacted]	109%
[redacted]	[redacted]	104%
[redacted]	[redacted]	103%
[redacted]	[redacted]	102%
[redacted]	[redacted]	102%
[redacted]	[redacted]	101%
[redacted]	[redacted]	99%
[redacted]	[redacted]	99%
[redacted]	[redacted]	97%
[redacted]	[redacted]	94%
[redacted]	[redacted]	94%

Limiting Element	Worst Contingency	Loading ('B' Rating)
[redacted]	[redacted]	93%
[redacted]	[redacted]	91%

The following table describes the proposed DESC transmission upgrades to mitigate the issues described in Table 4-1 and Table 4-2 for Case 4:

Table 4-3: Required Upgrades (Case 4)

Project Title	Project Work	Cost Estimate	Time Estimate (months)	Line Mileage	New Lines w/o ROW	New ROW Line Miles	New Stations
[redacted]							
	Acquire R/W	$5,445,000	48		1	38	
	[redacted]	$72,200,000	48	38			
		$500,000	18				
		$80,000	18				
		$734,000	24				
	Total	**$78,959,000**	**72**	**38**	**1**	**38**	**0**
[redacted]							
	1-1000 Cu to 2-1000 Cu at 12" apart, 1 ¼" Cu pipe to 5" Sch 40 Al	$90,000	24				
	Total	**$90,000**	**24**	**0**	**0**	**0**	**0**
[redacted]							
	Acquire Site	$80,000	18				
	Transmission work to fold	$500,000	18	0.5			
	Reactor Substation: Construct	$2,937,000	30				1
	Total	**$3,517,000**	**36**	**0.5**	**0**	**0**	**1**
[redacted]							
		$8,250,000	36	3.75			
		$151,000	18				
		$136,000	18				
	Total	**$8,537,000**	**36**	**3.75**	**0**	**0**	**0**
[redacted]							
	[redacted]	$78,400,000	54	32			
		$32,800,000	54	15			
		$950,000	18				
		$575,000	18				

Project Title	Project Work	Cost Estimate	Time Estimate (months)	Line Mileage	New Lines w/o ROW	New ROW Line Miles	New Stations
	[redacted]	$475,000	18				
		$750,000	18				
		$550,000	18				
		$75,000	18				
		$92,000	18				
		$53,000	18				
		$791,000	24				
		$500,000	18				
		$1,245,000	24				
	Total	$117,256,000	54	47	0	0	0
[redacted]							
	Clear and Grade Site	$600,000	18				
	[redacted]	$7,000,000	30				1
		$727,000	24				
		$1,000,000	36				
		$875,000	36				
		$1,464,000	24				
	Total	$11,666,000	36	0	0	0	1
[redacted]							
	Add R/W	$883,636	24				
	Transmission Construction	$14,904,000	30				
	[redacted]	$873,000	24				
		$873,000	24				
	Total	$17,533,636	30	0	0	0	0
[redacted]							
	[redacted]	$4,375,000	48	2.5			
		$7,600,000	42				
		$873,000	24				
		$160,000	24				
		$80,000	18				
		$80,000	18				

Project Title	Project Work	Cost Estimate	Time Estimate (months)	Line Mileage	New Lines w/o ROW	New ROW Line Miles	New Stations
	Total	$13,168,000	48	2.5	0	0	0
[redacted]		$82,000,000	48	40			
		$22,000,000	36	10			
		$3,000,000	42				
		$732,000	24				
	Total	$107,732,000	48	52.5	0	0	0
[redacted]		$3,750,000	36	10			
		$10,000	18				
		$244,000	24				
	Total	$4,004,000	36	10	0	0	0
[redacted]		$75,000	18				
		$300,000	24				
	Total	$375,000	24	0	0	0	0
[redacted]		$2,000,000	30				
	Total	$2,000,000	30	0	0	0	0
	Grand Total	$364,837,636	>=72	154.25	1	38	2

Notes:

- *Feasibility of new tie lines with neighboring utilities (other than SCPSA) has not been assessed by those utilities*
- *Time estimates assume the outages necessary to construct the upgrade projects do not conflict with each other; that is unlikely to be the case.*

Case 5

Case 5 consists of:

- The retirement of Wateree and Williams in 2028
- Contract for a 10-year PPA for 1100 MW off-system capacity-backed energy on a firm path from the SOCO interface or SOCO and DUKE

Thermal results are shown in the tables below; however, voltage results can be summarized by noting that, due to many various contingencies, widespread low voltage was observed below 0.95 per unit for the greater Charleston area and was as low as 0.80 per unit at many substations. The transmission projects identified to resolve thermal loadings also corrected the voltage violations.

Table 5-1: Single (N-1) Contingency Summary (Case 5)

Limiting Element	Worst Contingency	Loading ('B' Rating)
[redacted]	[redacted]	126%
[redacted]	[redacted] 30kV #1 and #2 Tie common	118%
[redacted]	[redacted]	118%
[redacted]	[redacted]	111%
[redacted]	[redacted]	110%
[redacted]	[redacted]	91%
[redacted]	[redacted]	91%

Table 5-2: Multiple (N-1-1) Contingency Summary (Case 5)

Limiting Element	Worst Contingency	Loading ('B' Rating)
[redacted]	[redacted]	145%

Limiting Element	Worst Contingency	Loading ('B' Rating)
[redacted]	[redacted]	133%
[redacted]	[redacted]	131%
[redacted]	[redacted]	116%
[redacted]	[redacted]	110%
[redacted]	[redacted]	107%
[redacted]	[redacted]	107%
[redacted]	[redacted]	107%
[redacted]	[redacted]	106%
[redacted]	[redacted]	103%
[redacted]	[redacted]	102%
[redacted]	[redacted]	101%
[redacted]	[redacted]	100%
[redacted]	[redacted]	97%
[redacted]	[redacted]	94%
[redacted]	[redacted]	94%
[redacted]	[redacted]	90%

The following table describes the proposed DESC transmission upgrades to mitigate the issues described in Table 5-1 and Table 5-2 for Case 5 worst-case:

Table 5-3: Required Upgrades (Case 5)

Project Title	Project Work	Cost Estimate	Time Estimate (months)	Line Mileage	New Lines w/o ROW	New ROW Line Miles	New Stations
[redacted]							
	Acquire Site	$4,550,000	18				
	Acquire R/W	$6,750,000	18				
	[redacted]	$7,669,000	30				1
		$1,750,000	30	1		1	
		$60,000	18				
		$60,000	18				
		$2,759,000	30				
		$60,000	18				
		$732,000	24				
		$1,750,000	30	1			
		$2,900,000	18	0.7		0.7	
		$22,000,000	36	10			
	Total	**$51,040,000**	**48**	**12.7**	**0**	**1.7**	**1**
[redacted]							
	Acquire Site	$1,125,000	18				
	Acquire R/W	$1,350,000	18				
	[redacted]	$6,796,000	42				1
		$1,200,000	30	1		1	
		$1,200,000	30	1		1	
		$58,600,000	48	61			
		$3,150,000	30	3.5			
		$150,000	24				
		$80,000	18				
		$80,000	18				
		$80,000	18				
		$10,000	18				

Project Title	Project Work		Cost Estimate	Time Estimate (months)	Line Mileage	New Lines w/o ROW	New ROW Line Miles	New Stations
	[redacted]		$25,000	18				
			$808,000	24				
			$1,057,000	24				
			$577,000	18				
		Total	**$76,288,000**	**48**	**66.5**	**0**	**2**	**1**
[redacted]								
	Acquire R/W		$5,445,000	36		1	30	
	[redacted]		$72,200,000	36	30			
			$500,000	12				
			$80,000	18				
			$734,000	24				
		Total	**$78,959,000**	**72**	**30**	**1**	**30**	**0**
[redacted]								
	1-1000 Cu to 2-1000 Cu at 12" apart, 1 ¼" Cu pipe to 5" Sch 40 Al		$90,000	24				
		Total	**$90,000**	**24**	**0**	**0**	**0**	**0**
[redacted]								
	Transmission Work for Fold In		$2,000,000	24	0.5			
	[redacted]		$120,000	24				
			$80,000	18				
			$80,000	18				
		Total	**$2,280,000**	**24**	**0.5**	**0**	**0**	**0**
[redacted]								
	Rebuild the 230/115kV Line		$8,250,000	36	3.75			
	[redacted]		$151,000	18				
			$136,000	18				
		Total	**$8,537,000**	**36**	**3.75**	**0**	**0**	**0**
[redacted]								
	[redacted]		$78,400,000	54	32			
			$32,800,000	54	15			
			$950,000	18				

Project Title	Project Work		Cost Estimate	Time Estimate (months)	Line Mileage	New Lines w/o ROW	New ROW Line Miles	New Stations
	[redacted]		$575,000	18				
			$475,000	18				
			$750,000	18				
			$550,000	18				
			$75,000	18				
			$92,000	18				
			$53,000	18				
			$791,000	24				
			$500,000	18				
			$1,245,000	24				
		Total	$117,256,000	54	47	0	0	0
[redacted]								
	Clear and Grade Site		$600,000	18				
	[redacted]		$7,000,000	30				1
			$727,000	24				
			$1,000,000	36				
			$875,000	36				
			$1,464,000	24				
		Total	$11,666,000	36	0	0	0	1
[redacted]								
	Add R/W		$883,636	24				
	Transmission Construction		$14,904,000	30				
	[redacted]		$873,000	24				
			$873,000	24				
			?	?				
		Total	$17,533,636	30	0	0	0	0
[redacted]								
	Acquire Site		$250,000	24				
	Acquire R/W for Fold Ins		$450,000	24			1	
	[redacted]		$9,920,000	30				1
			$1,500,000	36				

Project Title	Project Work		Cost Estimate	Time Estimate (months)	Line Mileage	New Lines w/o ROW	New ROW Line Miles	New Stations
	[redacted]		$320,000	24				
			$1,500,000	36				
		Total	$13,940,000	36	0	0	1	1
	[redacted]							
			$43,200,000	36	16			
			$1,500,000	24				
		Total	$44,700,000	36	16	0	0	0
	[redacted]							
			$4,537,500	42		1	20	
			$45,000,000	36	20			
			$53,750,000	36	25		25	
			$2,268,750	42				
		Total	$105,556,250	78	45	1	45	0
	[redacted]							
			$27,000,000	48	15			
			$800,000	24				
		Total	$27,800,000	48	15	0	0	0
	[redacted]							
			$4,375,000	48	2.5			
			$7,600,000	42				
			$873,000	24				
			$160,000	24				
			$80,000	18				
			$80,000	18				
		Total	$13,168,000	48	2.5	0	0	0
	[redacted]							
			$450,000	24				
		Total	$450,000	24	0	0	0	0
		Grand Total	$569,263,886	>=78	238.95	2	79.7	4

Notes:

- *Feasibility of new tie lines with neighboring utilities (other than SCPSA) has not been assessed by those utilities*
- *Time estimates assume the outages necessary to construct the upgrade projects do not conflict with each other; that is unlikely to be the case*

System Impedance/Short Circuit Analysis

A short circuit analysis was not performed for this Impact Analysis but would be required once the mitigation plan for retiring the Wateree and Williams generators is selected. Evaluating system impedances requires a comprehensive and accurate model, which is not possible at this early stage of the Impact Analysis. Note: there is a chance that the short circuit analysis could determine that changes are necessary to the layout or design of the Transmission System as prescribed in the list of upgrades above – overstressed circuit breakers cannot exist on the DESC Transmission System.

System Stability Analysis

A system stability analysis was not performed for this Impact Analysis. System stability may be affected by the removal of existing coal generators, changes in system topology and addition of new generation on the system. A system stability analysis will be performed during the generator interconnection process for proposed new generation and requires the availability of the PSSE dynamic models for the actual generators under study, which were not available for this process. In general, removal of large thermal generators from an area may weaken both frequency and voltage response to a fault in that area and may require additional system upgrades or changes in protection and control settings to mitigate.

For new generators, the stability analysis will assess the ability of the generator to remain in synchronism following selected Transmission System contingencies. The adequacy of the damping of generation/transmission oscillations, generator frequency responses and generator protective system performance as well as the impact of the proposed generator(s) addition or removal on the stability performance of other system generators will be evaluated during the interconnection study process.

Potential Contingent Facilities

Potential Contingent Facilities are those unbuilt Interconnection Facilities and Network Upgrades upon which a study's costs, timing, and study findings are dependent, and if delayed or not built, could prompt the need for a reassessment of the impacts of retiring the Wateree and/or Williams generators.

Potential Contingent Facilities fall into one of the following categories: facilities that were identified as part of DESC's expansion plans or facilities that were identified as part of an unbuilt generator interconnection project with a valid Interconnection Agreement. Network Upgrades or Interconnection Facilities identified solely to accommodate the retirement scenario assumptions used for this analysis are not considered to be Potential Contingent Facilities. The following DESC planned facilities and generators were included in the base cases for this analysis and, if delayed or not built, may impact the upgrades presented herein including costs, timing, or the need for a restudy.

The list of Potential Contingent Facilities for this analysis include the planned system improvements (also available on the DESC OASIS website) and unbuilt generator interconnections and their associated upgrades that have a signed Interconnection Agreement.

Planned Transmission Projects	Tentative Completion Date
Williams Street – Park Street 115kV**: Construct**	Dec-21
Lake Murray – Harbison 115kV**: Re-terminate Saluda Hydro – Harbison and rebuild SPDC**	Dec-21
Bluffton – Santee 115kV **Tie Line Construct**	Dec-21
Queensboro - Ft Johnson 115kV **& Queensboro-Bayfront 115kV (Queensboro-James Island Sect)**	Dec-21
Canadys 230kV**: Add Back-Back Bus Tie Breakers**	Dec-21
Batesburg - Ward 115kV **Line: Rebuild**	Dec-21
Edenwood Sub: Replace Switch house	Dec-21
Trenton – Briggs Rd 115kV **Line: Rebuild**	Dec-21
Cainhoy – Mt. Pleasant 115kV #1 and #2 (Horlbeck Creek Crossing)	Dec-21
Queensboro – Johns Island 115kV **Tie: Rebuild River and Marsh Crossing**	Dec-21
Toolebeck – Aiken (SCPSA) 230kV **Tie Line: Add three** 230kV **terminals to sub, Construct** 230kV **line, Fold in Graniteville #2 – South Augusta (SOCO)** 230kV	Apr-22
Burton-St Helena 115kV: Rebuild Burton-Frogmore Transmission Section	May-22
Graniteville #2-Toolebeck 115kV: Upgrade to 1272	Jun-22
Lake Murray - Gilbert 115kV **Line**	Dec-22
Burton-Yemassee 115kV **#2 Line Rebuild as Double Circuit**	Dec-22
Ward- Stevens Creek 115kV**: Ward – Trenton Section Rebuild**	Dec-22
Church Creek-Queensboro 115kV: Stono River Crossing	Dec-22
Denny Terrace–Crafts Farrow & Denny Terrace–Dentsville Line #1 115kV Rebuild	Dec-22
Eastover - Square D 115kV: Rebuild	Dec-22
Wateree-Hopkins 230kV Line #2: Rebuild	Dec-22
Calhoun County-St. Matthews 46kV: Rebuild	Dec-22
North-Wagener Jct 46kV: Rebuild North-LNG Tap Section	Dec-22
Lakeside 230-115kV Substation, Jasper – Yemassee 230kV #1 Fold-in and Lakeside – Okatie 115kV **line construct**	Jun-23
Denny Terrace Sub: Replace Switch house	Jun-23
Burton-St Helena 115kV: Frogmore Distribution - St Helena	Dec-23
VCS1-Denny Terrace 230kV & VCS1-Pineland 230kV: Rebuild Double Circuit Section and Single Circuit Sections	Dec-23
Wateree-Hopkins 230kV Line #1: Rebuild	Dec-23
Okatie-Bluffton 115kV: Rebuild	Dec-23
Square D - Hopkins 115kV: Rebuild	Dec-23
Cainhoy - Hamlin 115kV: Rebuild Line and Cainhoy – Hamlin 115kV **#2: Construct New** 115kV **Line**	Dec-24
Union Pier 115-13.8 kV Sub: Tap	Dec-24
Hopkins-CIP 230kV: Rebuild	Dec-24
Faber Place-Bayfront 115kV: Rebuild North Bridge Terrace to Bayfront Section	Dec-24
Edenwood Sub: #1 & #2 230-115kV Autobanks, Replace with 336MVA	Dec-24
Okatie-Riverport 115kV Construct	Dec-24
Wateree-Killian 230kV: Rebuild	Dec-25

Planned Transmission Projects	Tentative Completion Date
Canadys – Ritter 115kV: Rebuild as 230/115kV Double Circuit	Jun-26
Lakeside 230–115kV Sub and the Jasper – Yemassee Fold In	Dec-26
Ritter – Yemassee 230kV and 115kV Transmission System Expansion	Jun-27
Clements Ferry 115–23kV Sub: Construct; Jack Primus–Cainhoy 115kV with Clements Ferry Tap Construct	Dec-27

Unbuilt Generation with Signed Interconnection Agreements Included in Impact Analysis

Queue Number	Queue Type	Capacity (MW)
341	STATE	75.6
320	STATE	74.976
330	STATE	74.9
344	STATE	62
334	STATE	66

Conclusion

All cases analyzed in this Impact Analysis would prompt significant transmission upgrades to the DESC transmission system. Four of the five cases do not vary significantly in terms of upgrade costs but do vary considerably in terms of schedule risk and time required to complete.

The analysis of Case 1, which includes two phases, resulted in upgrades that cannot be accomplished by the proposed dates. In Phase 1, this conclusion is based on the time required to construct the upgrades necessary (assuming regulatory approval is not granted until 2023) to firmly import power for 3 years. Even in today's operating time horizon, many energy imports greatly exacerbate an already congested interface between DESC and Southern Company, and although the accelerated retirement of the Wateree plant is possibly achievable, the analysis shows that the import portion of the replacement scenario proposed by Case 1 cannot be achieved by 2025 because importing power will result in transmission congestion that must first be remedied.

The analysis does conclude that the addition of solar and energy storage at Wateree do not cause significant transmission issues and could be accomplished at relatively low cost and within the desired timeframe.

Though not studied in Case 1, an on-system solution to Wateree's retirement could significantly reduce the number of transmission upgrades that would be required and make Phase 1 possible in the required timeframe.

Phase 2 cannot be accomplished in the required timeframe either. Phase 2 would require the projects identified in Phase 1 to be completed first. Phase 2 then adds approximately 500 megawatts of

additional DESC generation to an existing ROW for 38 miles along the South Carolina coast. [redacted] he Jasper area, where DESC's system interconnects to the SCPSA and Southern Company systems, is already significantly challenged from a congestion standpoint. Adding more generation in that area would exacerbate the problem, [redacted] The time required to expand that 38-mile ROW and construct the associated transmission projects is expected to take a minimum of six years. Longer greenfield ROW from Jasper into another part of the DESC system may be an option but was not evaluated as part of this analysis.

Like Case 1, the analysis suggests the transmission upgrades necessary for Case 2 cannot be accomplished by the targeted deadline. Case 2 would result in 2000 megawatts of DESC generation located in the Jasper area, [redacted] Case 2 would also require significantly more ROW expansion than Case 1 and require at least eight years to construct. Additionally, Case 2 would require two new ties with Southern Company in the Jasper area to support power purchases and prevailing network flow. This is another area of risk for this scenario.

Case 3 requires no new ROW and is the only scenario that can be completed within the timeframe prescribed. Case 3 is also the lowest cost option. This case sites all the replacement generation at the existing Canadys substation which is at the site of the former Canadys generating station. [redacted] For this reason, Canadys is ideally located to support the load and voltage needs in the greater Charleston area. This is important considering the proposed retirement of the Williams plant. Further, siting generation at Canadys becomes more impactful when considering the eventual retirement of the SCPSA Cross coal plant, located in nearby Pineville, SC.

Like several of the other cases, Case 4 cannot be completed within the required timeframe. It is somewhat like Case 3, with significant generation sited at Canadys station. However, it also includes a long-term off-system purchase that would require transmission upgrades similarly to Case 1, Phase 1. As a result, transmission upgrades are required, including new tie lines with Southern Company. Case 4 also entails significant new ROW and long lead times to construct the necessary upgrades.

Case 5 is by far the most expensive and least desirable option from a transmission planning perspective. The required upgrades to support this case cannot be completed by 2028. Replacing over 1300 fully-dispatchable megawatts (more than 20% of DESC's historical peak demand) from the heart of the DESC system with energy imported from neighboring utilities brings the highest risk to reliability of any of the cases studied. As mentioned previously, imports do not offer the same essential reliability services or control that resources located on the DESC system allow. For example, voltage support is local in nature, and replacing a retired Williams plant with power generated hundreds of miles away won't provide the necessary voltage support to the fast-growing Charleston load center. Therefore Case 5 does not allow for a long-term solution and is the scenario that will suffer most from transmission congestion issues and possible curtailment of these proposed imports. DESC has experienced these

congestion issues many times while operating the system in real-time. Also, the analysis of Case 5 does not include the costs that would be required to procure firm long-term transmission service on the neighboring utility's system. These costs would be in addition to the transmission upgrades necessary for this case and would further increase the total cost. Finally, implementation of Case 5 would require several new ties with Southern Company.

This Impact Analysis is designed to provide an initial evaluation of the impact to the DESC transmission system of the five specified cases for the retirement of Wateree and Williams plants. Due to the highly integrated nature of the DESC and SCPSA systems, collaborative efforts were undertaken with SCPSA to evaluate these scenarios in conjunction with the planned retirement of SCPSA's Winyah generating plant. The results presented here assume SCPSA would undertake certain transmission upgrades that were determined as part of this process. Should SCPSA's plans change going forward, corresponding changes to DESC's plans may be required. Further analysis would be necessary to determine the specific impact of those changes.

The time and cost estimates provided for the transmission upgrade projects in this report are good faith estimates as of the fall of 2021. These time and cost estimates could and likely will change once the formal interconnection studies are conducted.

When a retirement strategy is finalized, formal interconnection requests must be submitted to DESC's interconnection queue as required by DESC's FERC-approved LGIP. As part of that process, formal System Impact Studies and Facilities studies will be conducted. Only at the conclusion of those studies will the impacts of these plant retirements and the associated upgrade projects be finalized. Affected Systems will also be identified as part of that process. Most, if not all, of these scenarios will have multiple Affected Systems identified.

Cases that included new tie lines with neighboring utilities, other than with SCPSA, included only the projects and associated cost and time to construct estimates on the DESC system for those tie lines. Ultimately, once a formal interconnection request or transmission service request is made, the feasibility of any new tie lines, and associated projects needed on the counterpart utility's system will need to be studied by that utility.

Only Interconnection Customers' projects with valid Interconnection Agreements were included in this assessment. There are many more interconnection requests in DESC's interconnection queue which have not yet been studied but which will have higher priority status than interconnection requests that may result from this Impact Analysis. These queued requests include significant amounts of generation in the Jasper, Williams, Wateree, and VC Summer areas. Once a full interconnection System Impact Study is undertaken, the results of that study may be quite different from those presented in this report.

To keep the Impact Analysis manageable, and to not overcomplicate the work performed under each case, the impact of the addition of 117-MW CTs connected at 230kV Williams Station was not evaluated as part of the Impact Analysis as allowed by Strategic Planning's letter. Nonetheless, DESC Transmission Planning believes that adding combustion turbine capability at Williams Station would be

very beneficial in terms of providing voltage support, reducing heavily-loaded lines, and providing operational flexibility in situations that may arise but have not been studied. Some transmission upgrade projects identified in this Impact Analysis may also be avoided, although the level of avoided investment may vary depending on the ultimate replacement scenario chosen as well as SCPSA's ultimate retirement plans. Further study will be needed to quantify the full benefits of adding CTs at Williams Station.

Finally, as seen by the cost estimates and time to construct the projects identified in this report, the transmission impact to DESC's system of the retirement of the Wateree and Williams plants, paired with the planned retirement of the Winyah plant, is very significant. The projects needed to ensure the reliability of the system is maintained are extensive. Meeting the targeted retirement dates will be extremely challenging, and in some cases, not feasible.